

Human-agent Collaboration Ontology (HACON)TM: Implications for Designing Naturalistic C² Decision Systems

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Presentation Overview

- Human-agent Collaboration
- Human-agent Collaboration in C²
- Understanding Agents
- Human-agent Collaboration Ontology
- Ontology Applications
- Naturalistic Decision-making Example
- Metrics
- Research Program

Human-agent Collaboration

- Is not one human – one agent
- Is more than human-agent communication language
- Goes well beyond human-agent interaction
- Is especially significant in complex decision-making applications

Emphasis is on capitalizing on the respective strengths of humans and agents during collaborative decision-making

Human-agent Collaboration in C²

- Military decision-making applications (e.g., C²) impose certain unique requirements on human-agent collaboration
 - ◆ adaptive human-agent collaboration architectures
 - ◆ dynamic function reassignment
 - ◆ decision-making under time-stress, uncertainty, risk

*Emphasis is on optimally leveraging the
human role in the face of ongoing changes*

Understanding Agents

- Agent Roles
- Agent Classification
- Human-agent Collaboration Regimes

Agent Roles

- Peers
 - ◆ develop shared understanding of task, their interdependencies, and contingencies
 - ◆ achieve seamless handoffs with shared understanding of context
 - ◆ deviate from “best practice” shared role when human is overloaded and/or fatigued, or unavailable
- Associate/Colleague
 - ◆ cooperates with human but performs different tasks than humans do
 - ◆ different from peer because this agent cannot be used to replace the human
- Assistant/Staff
 - ◆ agent performs tasks on behalf of the user
 - ◆ agent(s) has a clear notion of a goal and knowledge of the task domain to achieve it
 - ◆ shared vocabulary and task domain concepts enables terse, high-level human commands
- Teacher
 - ◆ pedagogical agent with domain as well as instructional knowledge
 - ◆ goal is transfer of knowledge/skills from domain KB/agent to learner
 - ◆ learning consists of getting to know and apply concepts, skills
- Learner
 - ◆ agent “learns” to perform tasks on behalf of the user; the information-seeking policy of the user

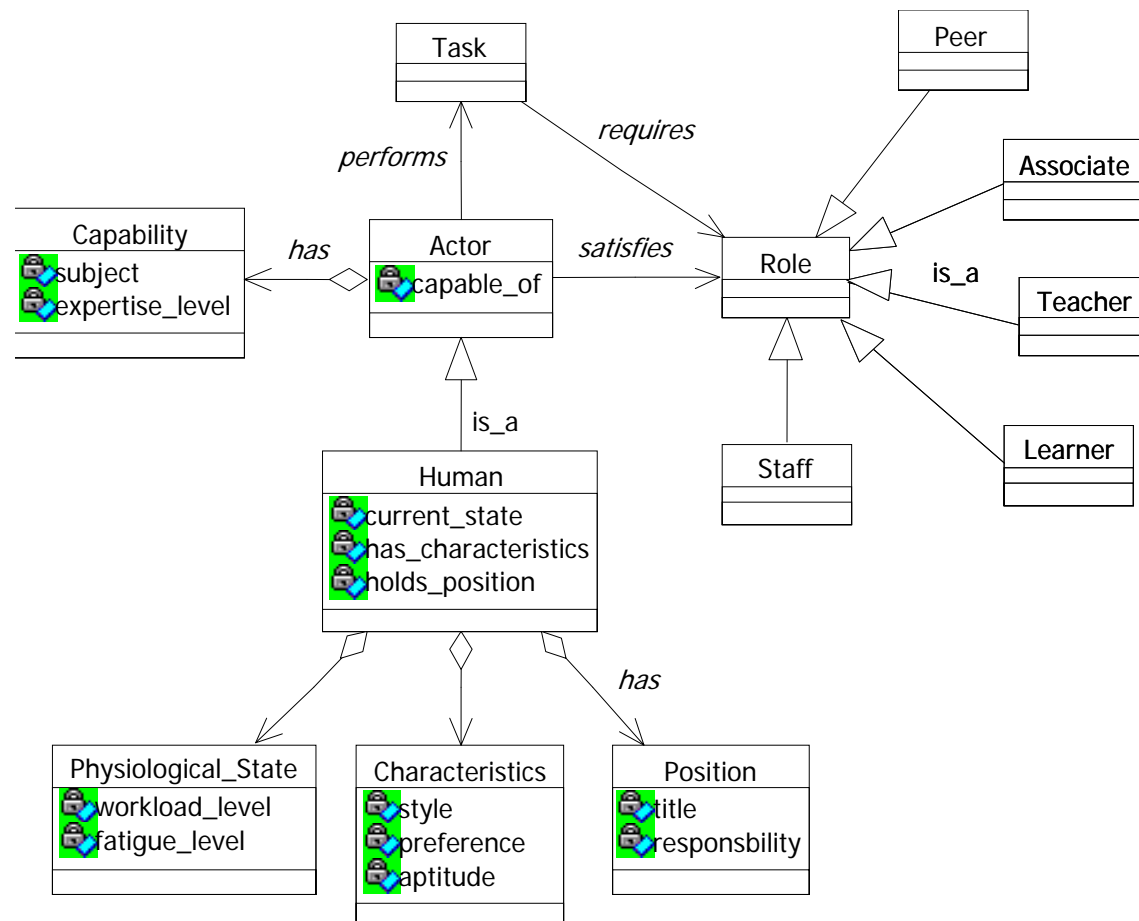
Agent Classification

- User agents
 - ◆ collect relevant information from user to initiate a task
 - ◆ interpret user commands/decompose user commands
 - ◆ assign work to task agents
- Task agents
 - ◆ have knowledge of the task domain as well as other task agents or information agents
 - ◆ coordinate with other task agents and information agents
 - ◆ form plans to achieve goals
 - ◆ executes plans
- Information agents
 - ◆ provide intelligence access to collection assets
 - ◆ are initiated either top down (by user or task agent) or bottom up by occurrence of particular information patterns
 - ◆ notify other interested agents when a particular condition of interest occurs
 - ◆ actively monitor information sources

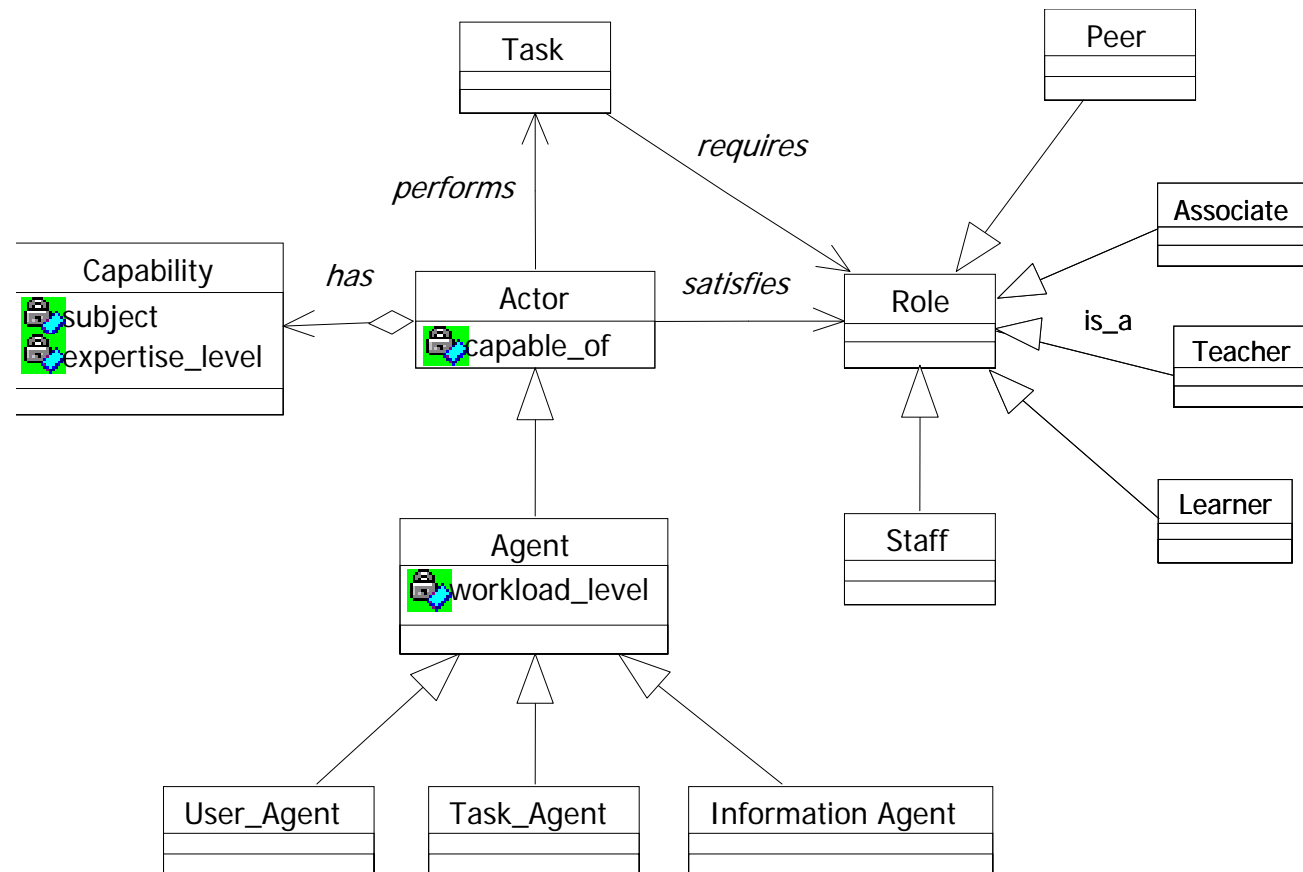
Human-agent Collaboration Ontology (HACON™)

- Human Representation Schema
- Software Agent Representation Schema
- Human-agent Collaboration Schema

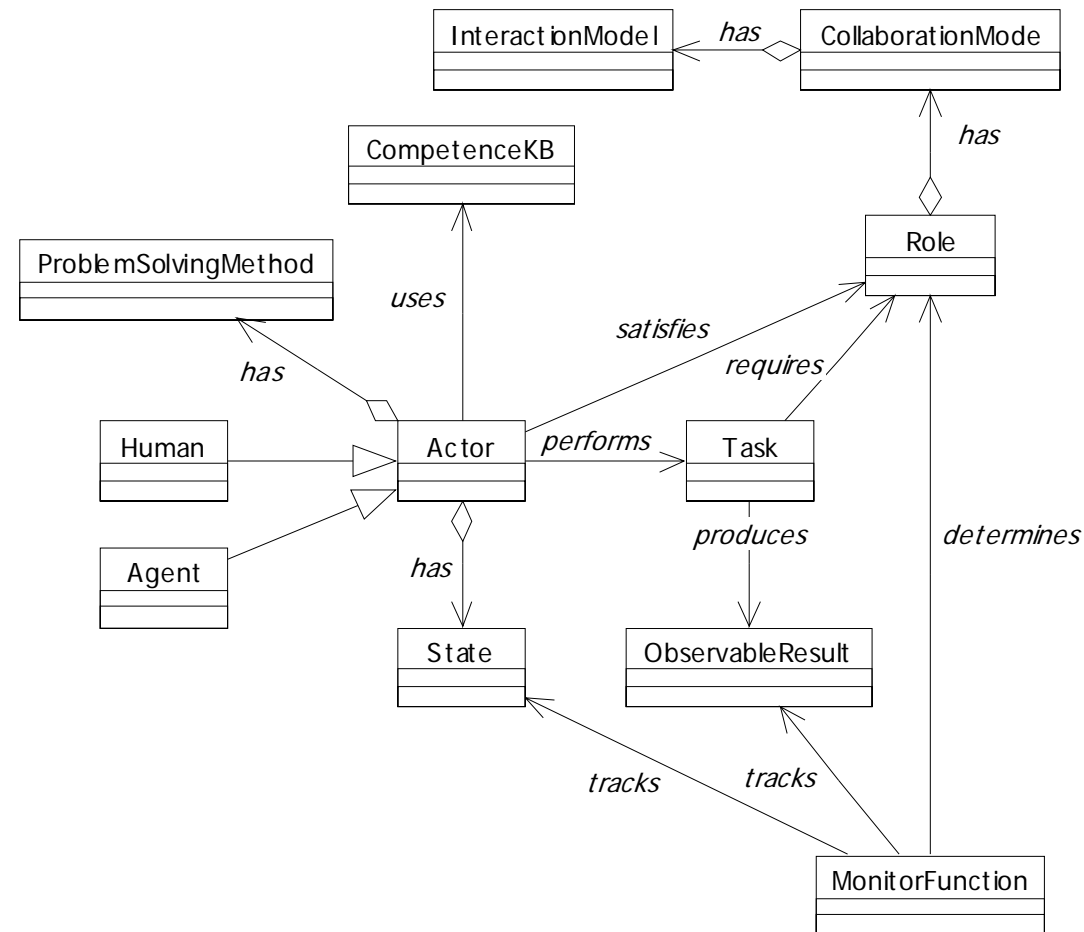
Human Representation Schema



Software Agent Representation Schema



Human-agent Collaboration Schema



Ontology Applications

- Decision-making
- Planning
- Decision support
- Design

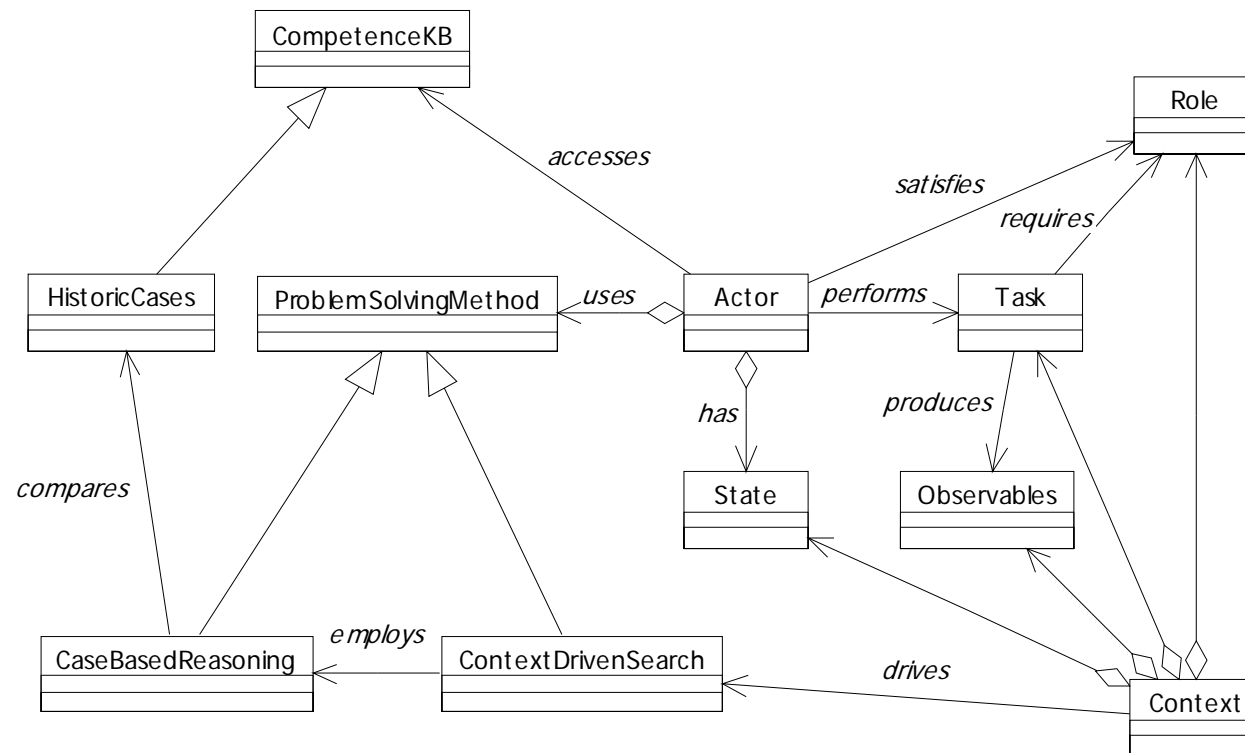
*For example, HACON can be extended
for naturalistic decision-making*

Naturalistic Decision-making

- Simply described as “*the way people use their experience to make decisions in field settings*”
- Emerged from the study of how real people make real decisions in real situations
- Well-suited to describing how decisions are made under time-stress, uncertainty, and risk

NDM has yet to be exploited within Decision Support Systems!

NDM Schema...

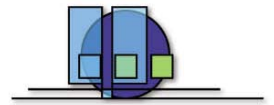


... is the first step to operationalizing naturalistic decision-making within DSS

Case-based Reasoning...

- Exploits heuristics and knowledge of previous cases to find a solution to a current problem
- Solution typically takes the form of an adaptation of a solution to a previous case

... is the second key component for operationalizing NDM within DSS



NDM Implementation in DSS

NDM Concepts	Implementation
Familiar Situations	– Similar cases (based on ontology)
Situation Familiarity Assessment	– Based on reachback for relevant cases using case-based reasoning
Activation of Information from Memory	– Agent tasking (user agent) – Context-driven search of historical cases (information agent)
Evaluation of Suitability of Contemplated Action	– Case-based reasoning; similarity metrics
Implementation of Action	– Execution of plan/workflow associated with “best-fit” case (task agent)

Sample Metrics

- Human cognitive load
- Agent utilization statistics
- Task completion times for various human-agent function assignments
- Execution delay due to function reassignment
- Execution delay due to resource unavailability
- Multi-agent synchronization delay due to function reassignment

Research Program

- Create “cognitively-inspired” software testbed based on HACON to investigate performance impacts of:
 - ◆ adaptive human-agent collaboration architecture
 - ◆ dynamic function reassignment options
 - ◆ context switching between human and agents
 - ◆ agent learning

We need to understand these issues before we can effectively exploit the human role in shared human-agent C² decision-making systems.



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